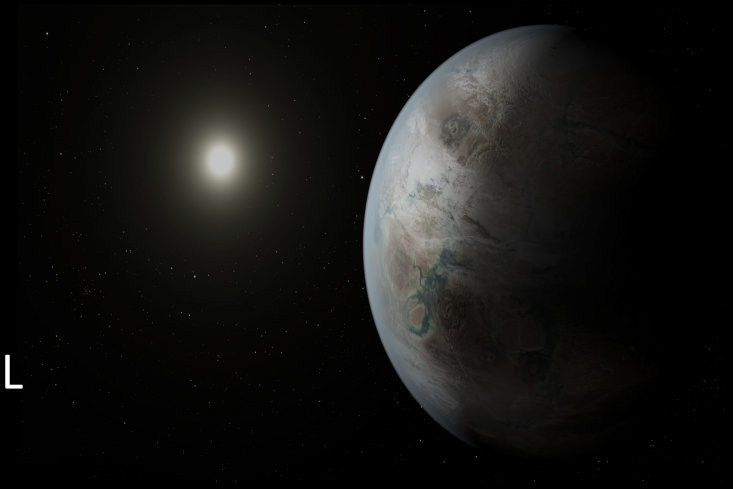


Habitable Exoplanet (HabEx) Imaging Mission Concept Study Planning

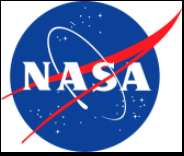
Bertrand Mennesson, JPL
HabEx Study Scientist



Credits: NASA Ames/JPL-Caltech/T. Pyle

Astrophysics Subcommittee Meeting, NASA HQ, March 16 2016

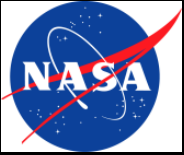
B. Mennesson, APS presentation



Summary



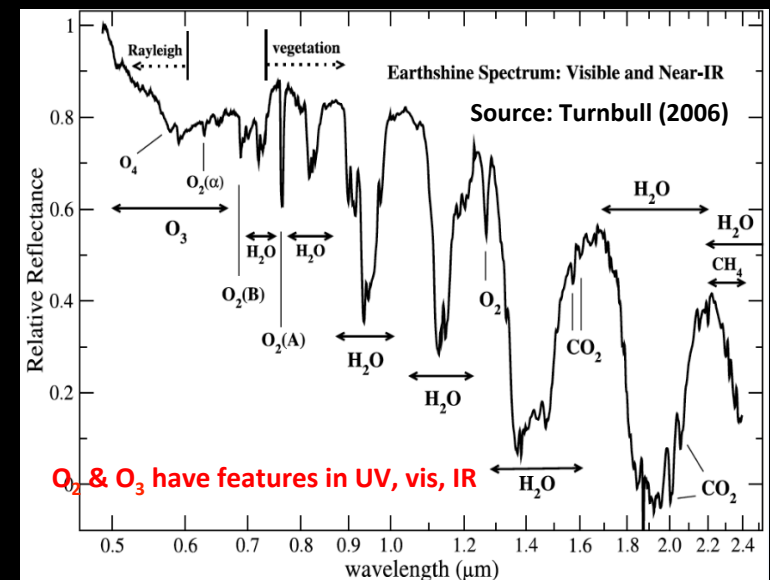
- What is the HabEx concept?
- Why do we need to study the concept?
- What is the current state of the HabEx Science and Technology Definition Team (STDT)?
- What is the current state of the study office team?

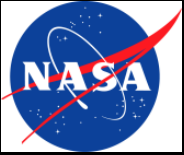


HabEx Science Goals and Concept



- Overall Concept is open and to be defined by STgT and science community with support from the study office
 - Tany design options a priori possible (on/off axis telescope, segmented or not, internal coronagraph and/or external starshade)
- Primary science goal: search for and characterize potentially habitable worlds
 - Characterize Earth-sized planets in the HZ of nearby stars via direct detection and spectroscopic analysis of their reflected starlight
 - Understand the atmospheric and surface conditions of those exoplanets
 - Specifically, search for water and bio-signature gases on those exoplanets
 - Search for signs of habitability and bio activity in non-Earth-like exoplanets

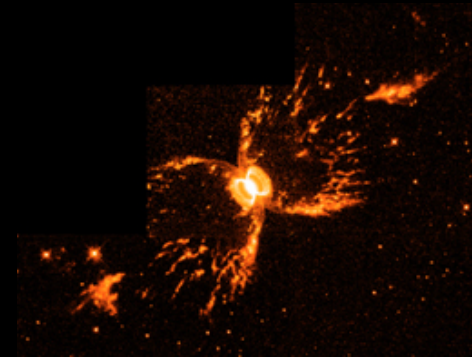


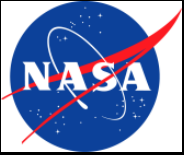


HabEx Science Goals and Concept



- Primary Goal Requires a large ultra-stable space telescope with a unique combination of
 - Very high spatial resolution (< 30 mas) and dynamic range ($\sim 10^{10}$)
 - High sensitivity / exquisite detectors in the optical (possibly UV and NIR)
- Such a facility will necessarily also provide exceptional capabilities for
 - Characterizing *full* planetary systems, including rocky planets, “water worlds,” gas giants, ice giants, inner and outer dust belts
 - Conducting planet formation and evolution studies
 - Star formation and evolution studies
 - Studying the formation and evolution of galaxies
 - Other general Astrophysics applications
- STDT will direct design team to explore key trades (λ , D, FoV, R)
 - For the primary science goal and for non-exoplanet studies (secondary payload(s))





Why do we need a concept study?



- Need to fold in recent advancements in scientific knowledge and high contrast imaging technology:
 - Only recently have the Kepler results constrained η_{Earth}
 - Final analysis of Kepler results and η_{Earth} value to come mid 2017
 - New powerful post-processing techniques for high contrast imaging (HST/ Ground)
 - More advanced laboratory/field demonstrations of internal coronagraphs and star shade technology over the last 5 years



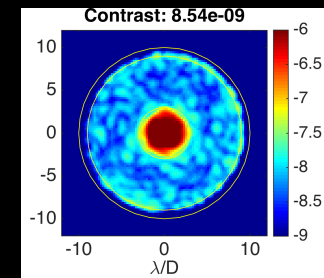
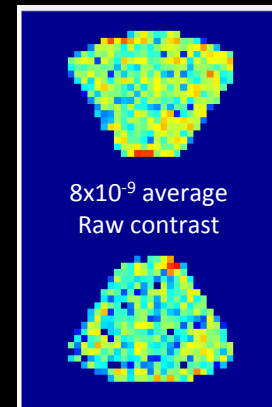
Coronagraph
Masks



High-Contrast
Imaging

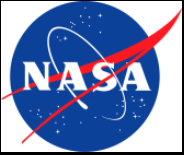


Deployable
Starshades



WFIRST-like aperture broad-band lab demos

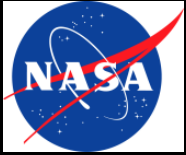
- Exo-C and Exo-S probes were targeted at \$1B
 - HabEx Concept study will aim to understand how to scale up and build up on these studies



Current State of STDT Selections



- “An embarrassment of riches”: 88 very high profile scientists and technologists applied to the HabEx STDT
- Very competitive selection process led by HQ, in consultation with ExEP, JPL study team and study chairs
- Ensure a community-led study by maximizing community membership
- Ensure some continuity with exo-C/ exo-S studies
- Ensure a good balance in terms of expertise between:
 - The various fields of (exo)-planets + disks science and technology
 - General astrophysics themes enabled by the largest diffraction limited optical telescope in space



STDT Selections

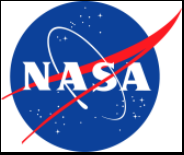


Community Chair	Cahoy, Kerri (MIT)	Space Systems technology and Xpl spectra
	Domegal-Goldman, Shawn (GSFC)	Bio-signatures and Xpl spectra
	Feinberg, Lee (NASA GSFC)	Picometer wavefront control
	Gaudi, Scott (Ohio State) [Co-Chair]	Xpl Demographics / WFIRST
	Guyon, Olivier (Arizona)	Coronagraph design / Wavefront control
Center Study Scientist	Kasdin, Jeremy (Princeton)	Starshade and Coronagraph designs
	Mawet, Dimitri (Caltech)	Coronagraph design / Disks/ Post processing
	Mennesson, Bertrand (JPL)	Debris disks / High Contrast Imaging
	Robinson, Tyler (UC Santa Cruz)	Atmospheric spectral retrieval
	Rogers, Leslie (Chicago)	Low mass Xpl Interior structure & evolution
Community Chair	Scowen, Paul (Arizona State)	General astro/ UV/ ISM COPAG Chair
	Seager, Sara (MIT) [Co-Chair]	Starshade / Bio-signatures
	Somerville, Rachel (Rutgers)	Star and galaxy formation / theory vs observations
	Stapelfeldt, Karl (NASA JPL)	Disks/ ExEP CS
	Stern, Daniel (JPL)	General astrophysics/ AGNs/ NIR
	Turnbull, Margaret (SETI)	mission design / target selection

CNES Observer: Mouillet, David (IPAG) – CSA Observer: Marois, Christian (NRC Canada)

DLR Observer: Quirrenbach, Andreas (Heidelberg)

**THANKS TO ALL APPLICANTS! WARM CONGRATS TO THE 16^(*) HABEX STDT MEMBERS: WELCOME ABOARD !!!
KICK-OFF MEETING IN SPRING 2016**



Status of Study Office Team



- **Core Team being built as we speak, but most key roles already filled:**
 - K. Warfield (Study Manager), B. Mennesson (Study Scientist),
 - D. Breda (Lead Systems Engineer), S. Martin (Lead Instrument Engineer)
 - S. Shaklan and D. Lisman (Coronagraph and Starshade Technology),
 - P. Stahl (MSFC, Optical Design and Development)
 - R. Morgan (“Standards Team” Coordination)
 - Additional contracts to support science yield calculations? Assess impact of prior high precision RV measurements?
- **Developing plan to maximize the efficiency of engaging with**
 - LUVOR Team (monthly telecons/ share and exchange engineering resources)
 - Existing Projects / Missions (WFIRST-CGI tech developments, Kepler & LBTI findings)
 - ExEP appointed Exoplanet Standard Definition and Evaluation Team, StarShade Readiness Working Group (SSWG), Segmented Aperture Design and Analysis Group (APD funded in FY16)
 - Industry partners: host HabEx “Industry Day” early in the study
- **Preparing for delivery of concept study deliverables to HQ**
 - Comments on study requirements and deliverables, due April 29, 2016
 - Deliver initial technology gaps for inclusion in ExEP, SAT/TDEM, and APRA Proposal Cycles, due June 30, 2016
 - Detailed 3 year study plan and schedule of MS delivery, August 26, 2016